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AUTHOR Morse, Frances K.; Daiute, Colette
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ABSTRACT

There is a burgeoning body of research on gender differences in computing attitudes and behaviors. After a decade of experience, researchers from both inside and outside the field of educational computing research are raising methodological and conceptual issues which suggest that perhaps researchers have shortchanged girls and women in documenting the computer gender gap. A need is identified for more research on computing activities which are not related to mathematics or programming and which look at what women and girls do like about computers. A multi-week observational study of gender-sensitive computer attitudes in a gender-sensitive context was conducted in a suburban high school in Massachusetts during the spring of 1990, using the Personal Media Studio, Macintosh HyperCard-based multimedia writing software. This study involved 42 adolescents (25 females, 17 males), in two low-middle ability sophomore English classes. Ranging in age from 14-17, the students were racially and ethnically diverse. The results showed that females expressed positive, enthusiastic, and confident feelings about computers, and it was concluded that Likert scale computer attitude surveys are an example of the mismeasure of women. This report reviews the literature on gender differences in computing attitudes and behaviors and examines the research results in terms of: (1) methodological issues; (2) measurement instrument formats; (3) controversies regarding attitude research; (4) feminist challenges; (5) underlying assumptions about the computer; and (6) insufficient contextual details. Seven tables display the data and an extensive bibliography is provided. (ALF)

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I LIKE Computers Versus I LIKERT Computers:

Rethinking Methods for Assessing the Gender Gap in Computing

Frances K. Morse and Colette Daiute
Harvard Graduate School of Education

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Frances K. Morse is an Ed.D. candidate in Human Development and Psychology at the Harvard University Graduate School of Education.

Colette Daiute is Associate Professor in Human Development and Psychology at the Harvard University Graduate School of Education.

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Abstract

Heralded as saviors for schools, computers have generated excitement, skepticism, and a burgeoning body of research on gender differences in computing attitudes and behaviors. It has been reported that males are more confident about their computer skills, use computers more often, and are less anxious about computers than their female counterparts. However, after a decade of experience, researchers from both inside and outside the field of educational computing research are raising methodological and conceptual issues which suggest that perhaps researchers have shortchanged girls and women in documenting the computer gender gap. First, we summarize the literature on gender differences in computing attitudes and behaviors. We then critically examine these research results in terms of (a) methodological issues, (b) measurement instrument formats, (c) controversies regarding attitude research, (d) feminist challenges, (e) underlying assumptions about the *computer*, and (f) insufficient contextual details. We follow this critique with some suggestions for future gender research in educational computing. Finally, we present some of the results from an observational study as a model for implementing our suggestions. Our results from this study of urban adolescents using Macintosh multimedia software uncovered a picture of females and computers that contradicts what is often reported in the literature.

Literature Review

During the decade of the 1980's microcomputers were placed in educational settings at unprecedented rates. Researchers armed with time-efficient Likert scale instruments quickly followed these electronic saviors into classrooms to examine their effects -- sometimes unclear or unknown even to the educators responsible for their uses. What has emerged over these last ten years is a body of literature that gives the surface impression that there are major gender differences (in favor of males) in computing attitudes and behaviors. Although there are a few *female success* stories, (For example, Loyd, Loyd, and Gressard, 1987; Forsyth & Lancy, 1989; Marshall & Banyon, 1986), the literature abounds with research articles about this reported gender gap in computing. Headlines such as *Sexual Stereotypes Taint Computer Classes* (Patterson, 1984), *Computerphobia: What To Do About It?* (Jay, 1981), *Psychosocial Implications of Sex Differences in Attitudes Toward Computers: Results of a Survey* (Collis, 1987) and *Children and Computers: Do Sex-Related Differences Persist?* (Krendel, Broihier, & Fleetwood, 1989) present a picture of large numbers of females, from kindergarten to

college, shying away from technology - thus suffering "dire consequences" which will leave them "increasingly behind in a technological society" (Lockheed, 1985, p.120). Researchers document male-dominated video game arcades (Braun, Goupol, Giroux, and Chagnon, 1986; Loftus & Loftus, 1983), male-dominated computer camps (Lockheed, 1985), and male-dominated after-school computer clubs (Becker, & Sterling, 1987; Chen, 1986, Miura, 1986). We read about boys taking over the computer keyboards in elementary classrooms, leaving their more passive female classmates to cry out, "They get on it before we can get to it" (Reece, 1987, p.3).

Gender differences seem especially prominent regarding attitudes towards computers. Across all grades, the computer is perceived as more appropriate for boys than girls (Wilder, Mackie, and Cooper, 1985). Males are reported to be more confident about their computer skills, have more interest in computing, and feel less anxious about computers than their female classmates (Collis, 1987; Becker & Sterling, 1987; Chen, 1986; Miura, 1986). And at the college level, Sproull, Zubrow, and Kiesler (1986) describe computing as an "alien culture" in which novices, especially females, experience "reality shock" and often elect to turn away from further computer experiences. We are left with the impression that girls respond negatively to computers and avoid them if at all possible. This impression extends to the culture outside of schools in newspaper headlines such as *Computing in America: A Masculine Mystique* (Markoff, 1989), in television shows such as Oprah Winfrey's *Women Who Can't Program their VCR's*, and in advertisements in popular computer magazines in which men outnumber women 3:1 and are shown in more active, hands-on roles (Ware & Struck, 1985; Marshall & Banyon, 1988).

Indeed, things look so bleak that some researchers (Kramer & Lehman, 1990) are claiming that women and girls are just expected to avoid computers. Others warn that building expectations about differences can actually create differences. In fact, "so many writers have commented on these differences that these opinions themselves may lead to negative attitudes on the part of females and the subsequent avoidance of technology" (Hattie & Fitzgerald, 1987, p. 4). [1]

However, after a decade of experience, researchers from both within and outside the field of educational computing research are beginning to reflect on and question what has been reported about these gender differences in computing attitudes and behaviors. We ask, "Have the methods used to assess computing behaviors and attitudes shortchanged girls and women?" We explore this question in both methodological and conceptual terms.

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[1] Perhaps this is the computer version of the Werther effect regarding suicides.

Methodological Issues

On a general level, there is certainly a zeitgeist regarding gender equity in educational research as well as practice. Researchers concerned with equity issues (Notman & Nadelson, 1990; Tavris, 1990; Gilligan, 1982) point out the problems of gender bias in research methods and perspectives, suggesting that researchers must start questioning more thoroughly (1) how questions are asked and (2) how data are gathered McHugh, Koeske, and Frieze (1986). Campbell (1988) writes that gender research tends to focus on the deficit model - reporting who's better and who's worse, often ignoring or overlooking how the genders might be similar. In practice, schools are shortchanging girls in classroom interactions and curricula, especially math and science (AAUW, 1992; Sadker, Sadker, & Klein, 1991; Gilligan et. al., 1990; Tittle, 1985). These reports are adding to a growing body of literature which points out differences in the lives and experiences of girls and women - differences which perhaps have not been addressed adequately in the research on computer attitudes and behavior.

Some researchers from within the field of educational computing research itself are beginning to examine more carefully this body of literature on gender differences in computing, pointing out the wide variation in how computer constructs are defined and the inconsistencies regarding which constructs tend to be associated with gender differences. For example, Kay (1990a) conducted a methodological analysis of 55 studies on gender differences and concluded that "although some exemplary studies have been done, for the most part investigators have been slipshod in their methodology" (p.21). In categorizing the 55 studies, Kay identified 15 different ways researchers had defined computer attitudes, 8 ways computer aptitude had been defined, and 7 ways computer usage had been defined, across all ages from kindergarten through college, teachers as well as students. He concluded that what we have is "quagmire of constructs and age groups" from which it is difficult to find consistent patterns. Indeed, out of 82 instances of attitude measurement (some of the studies had multiple measures), males had more positive attitudes on 30 occasions (36%), females had more positive ones on 19 occasions (23%), and the genders were similar in computer attitudes on 33 occasions 38%).

Sutton (1991), reviewing this literature in terms of gender and race, also found inconsistencies, but unlike Kay, reported no studies that found gender differences in favor of females. In 15 studies of computer access involving 12 comparisons of school

use, three (25%) studies found significant differences in favor of males, seven (58%) found nonsignificant results favoring males, and only two studies found no differences in school use. Differences were much greater in terms of home computer usage. Out of 15 comparisons regarding home access, ten (66%) found significant differences in favor of males and the remaining studies found nonsignificant differences in favor of males. In 18 attitude studies, Sutton (1991) listed 7 ways in which attitude towards computers was defined (male domain, general, interest, liking, utility, confidence, and anxiety). She found the strongest gender differences favoring males (higher scores) in attitudes defined as *computer as male domain*, *computer anxiety*, *utility*, and *general*. Although Sutton did not mention it, there were no gender differences in 4 out of 7 of the *computer confidence* comparisons, 3 out of 4 of the *computer liking* comparisons, and 4 out of 6 of the *computer interest* comparisons.

Researchers have also commented on the "absence of statistical rigor" (Kay, 1990a, p. 3) in much of this research on gender differences in computing behaviors. Kay documented a number of procedural flaws regarding sample selection (small sizes, use of volunteers, or worse, no information about the sample), scale development and quality, validity of constructs, choice of analysis methods (univariate versus multivariate), and presentation of results. Hattie and Fitzgerald (1987) in trying to conduct a meta-analysis of this literature, identified 124 potential studies for their systematic review. However, they concluded that most of the articles were "statements of opinions" (p. 5) about gender differences rather than good empirical research. Because of the quality of the data and methods, they were only able to use 19 (15%) of the studies.

Measurement Instruments: Questions and Formats

Another methodological aspect which needs to be examined is the style and format of the questions in many of the instruments, referred to by the British as "put a tick-in-the-box" Likert scales (Solomon & Harrison, 1991). Although there is some variation, the typical format is a set of short, simple statements often written in the third person, such as *Computers make me feel uneasy and confused* (Loyd, Loyd, & Gressard, 1987), *Computers make me feel dumb* (Richards, Johnson, & Johnson, 1986), or *Computers are threatening* (Todman & File, 1990). The subject responds by selecting a number along an *agree/disagree* discrete numeric scale, ranging from 3 to 9 points with higher numbers indicating more positive attitudes. However, middle points of such scales are often unclear. Do they represent *neutral* or *Don't know* or *no opinion* or *unsure*?

Likert scales can be a big source of measurement error (Light, Singer, and Willett, 1990), and there is research evidence that such formats may not be an accurate way to measure female responses to computing. In an interview study of women who had just completed a Likert scale parental attitude test, Holden and Edwards (1987) found that the women often could not remember what they had answered, wanted more situational details in the questions, had never thought about some of the questions and thus wondered how to answer them, often were confused by the response scales, and had to control their desire to check the socially desirable answer. As one mother poignantly stated, "I always sat there and analyzed it until I messed it up" (p. 45).

British researchers Grant and Harding (1987), went beyond the routine reporting of the *average* computer attitude scores and examined the response patterns in their 5-point Likert scale questionnaires about science and technology (*Money spent on science and technology is well worth spending*). They found that proportionately more positive as well as negative responses came from boys and proportionately more *not sure* (middle of the scale) responses came from girls. Follow-up interviews with a sample of the girls revealed that they gave *unsure* responses because "It depends on the situation" and "It depends on what you mean by science and technology". The authors claim that the females had a more complex view of the advantages and disadvantages of technology which was not reflected in the *average* attitude scores which showed that the girls were significantly more negative.[2]

Other British researchers (Solomon & Harrison, 1991) found gender differences when analyzing Likert scale questionnaire data about science and technology-based issues but not when analyzing conversation transcripts of mixed-gender high school groups discussing technology issues. The females, in the context of conversation, not putting ticks in boxes, showed technical confidence and knowledge.

Attitude Research Controversies

There is certainly no lack of research on gender differences in computing attitudes. However, it appears that most computer researchers (with the exception of Kay, 1990; Abdel-Gaid, Trueblood, & Shrigley, 1986) have not been cognizant of the never-ending debates about attitude-behavior consistencies (For example, see Cooper & Coyle, 1984). Mishler (1984) citing Abelson, discusses the "mess" of current attitude

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[2] We note that some computer attitude questionnaires include instructions such as "Try not to select "UNSURE" (Todman & File, 1990) - which might be a disadvantage for females. Grant & Harding (1987) think that "unsure" is a valid answer, that to be critical is to be positive, and that perhaps the girls have it right about technology.

theory and research and "its failure to find attitude measures that correlate with overt behavior" (p. 8). Shrigley (1990) paints a "bleak picture" (p. 98) of this controversial area of research - which is reflected in the titles of texts used within the field - *Are Attitudes Necessary?* (Abelson, 1972), *Attitudes: A Mental Myth* (Tartar, 1970), and *The Consistency Controversy* (Liska, 1975). Although complex models have been posited for the relationship between attitudes (For example, Ajzen & Fishbein's *Theory of Reasoned Action* (1980), most researchers in educational computing seem to follow the simplistic model that attitudes precede and predict behavior and that fostering positive computer attitudes, as measured by easy-to-administer Likert-scale instruments, will lead to increases in computer usage and achievement (Richards, Johnson, and Johnson, 1986; Bear, Richards, & Lancaster, 1987, Todman & File, 1990). Certainly, we might ask if such computer attitude scores can be expected to reflect actual behaviors in a computer environment.

Feminist Perspectives

Although only recently venturing into the technological arena, feminists raise some interesting issues relevant to the research on gender differences in computer attitudes and behaviors. Some feminists (Jansen, 1989; Wajcman (1991) describe the absence of a critical consciousness regarding gender issues in technology, reminding us of the male monopoly of this field. Men design, build, and repair machines and determine their uses; women are consumers of them. We still have journals with titles such as *International Journal of Man-Machine Studies* and international conferences about research on *Man-Computer Interaction* (Klix & Wandke, 1984) -- such titles giving the impression that serious computer research excludes women.

Feminists also question the discursive practices that have grown up around technology and see the need to *unpack* these if we are to truly understand what it means to engage in computing (Honey et al., 1991). For example, the hostile vocabulary of technological discourse with its macho metaphors and martial language may alienate some women. Users of those ubiquitous IBM DOS computers have to EXECute a program and ABORT a recalcitrant disk. (Fortunately, the Macintosh offers an alternative.) Users of Digital Equipment's X Toolkit software have to read documentation which refers to certain computer functions as "children" and contains instructions for "the overall management of children from creation to destruction" (Perry & Greber, 1990, p. 90). Such terminology may cause women to feel conflicts between

the "cultural construction of being a woman" and the "cultural associations of the technology" (Turkle & Papert, 1990, p. 151).

Recent qualitative research supports this feminist perspective. Researchers at Bank Street College's Women and Technology Project, building on the work of Gilligan (1982), found that men tend to see computers as machines which extend their power, getting excited about the computer itself while women approach the computer more relationally, seeking ways to capture its power for the service of and connection with other people (CCT & CCE, 1991). And Turkle & Papert (1990) identified two distinct styles of relating to a computer -- a relational style that is artistic, almost tactile, and playful -- associated with females -- and a risk-taking style that tests the machine limits -- more associated with males. They call for an "epistemological pluralism" (both in practice and in research) which will recognize and value both styles.

How The Computer is Portrayed

We also question how the computer is represented in much of this research. As Marshall & Banyon put it, "Nothing in all of education seems to shake more cages and create more debate than the word *computer* (1986, p. 270). One might ask just exactly what is a *computer*? Sherry Turkle (1984) needed an entire book to describe what this seemingly simple object means to different people and the different ways males and females respond to it. We wonder if a psychological machine which people see as a *second self* on the border between mind and not mind -- alive and not alive -- and which generates emotions from euphoria to paranoia can be captured in a questionnaire statement such as *I like computers*.

Most studies treat the computer in its *canonical* form as a number cruncher or a device to be programmed and mastered, or as Jansen (1989) has described it -- the "Cartesian dream of a lean, clean, machine of reason" (p. 203). However, as computing technology has advanced, so has the breadth of possible applications. The computer has become more intuitive and visual - and can be used by people who like to relate to the world through "intuition and visual impression" and "the power of words and associations" (Turkle & Papert, p. 131). Yet research on new machines such as the Macintosh and new applications such as multimedia and advanced graphics has lagged behind - leading to an "increasingly inaccurate portrayal" of what computing can be (Kramer & Lehman, 1990, p. 170).

Finally, we question the prevalent research assumption that there has to be a close relationship between computers and mathematics (Culley, 1988; Dambrot et al., 1985).

Early warnings for educators and researchers to be careful not to allow the computer to "become part of the intimate connection between males and math" (Sheingold et al., 1983) may have gone unheeded. Kramer & Lehman (1990) point out that the gender gap in computing attitudes and behaviors "shares a common etiology with women's avoidance of mathematics" (p. 159). A common view among many researchers seems to be that computer aptitude is related to math aptitude and that "people in general and women in particular who have problems with mathematics will find working with computers even more difficult and threatening" (Dambrot et al., 1985 p. 71). This computer-math connection is so tight that some researchers have thought it appropriate to modify existing *math* aptitude, attribution, and anxiety instruments so that they measure similar computer constructs (Campbell & Williams, 1990; Richards, Johnson, & Johnson, 1986). Some researchers even expressed surprise when their computer attitude scores did not correlate with math aptitude scores (Bear et. al., 1987; Abdel-Gaid, et. al, 1986).

Lack of Contextual Details

A final reason to question the research studies on gender differences in computing is the lack of *computing context* . As Tavris (1990) noted, "behavior linked to gender depends on the situation." Contextual factors - not just the computer as an object - are important in assessing why people respond differentially to computers. Papert (1987) has suggested that researchers are too technocentric, focusing more on the computer than on the people who use it and the culture that surrounds it. Most computing studies that report significant gender differences "tend to describe the computer as a unitary topic rather than attending to the characteristics of a particular situation where the differences are found" (Hawkins, 1985, p. 171). Broad statements such as "the computer program at School B was known to be one of the best in the area" (Pulos and Fisher, 1987, p. 31), "excellent teaching was a factor in how well the students learned programming" (Linn, 1985), and "the extent and creativity of use depended on the individual teacher" (Krendl et al., 1989, p. 88) are included without important elaboration about the nature of the computer tasks, activities, technical support, interactions, teaching style, and settings which may have led to the gender differences.

Suggestions for Future Research

To conclude this critique of a decade of research, we agree with Kay who pointed out that most of the studies on gender differences in computing attitudes and behaviors

have used a quantitative, survey-based, short-term, and cross-sectional approach which has produced a "surprisingly lifeless, inert, and static" (1990b, p. 3) picture of computing behaviors. A reader of this literature is left with an "empty feeling, a nagging suspicion that something is missing" (p. 3). Kay, as well as Sutton (1991) argue for a change in research emphasis - a shift from quantitative, categorical research describing existing problems to a more qualitative, contextual, and process-oriented approach which perhaps will be more explanatory. We also think there should also be more studies which include both observations and written assessments of attitudes - an "exceedingly rare" methodology in this field (Sutton, 1991; Kay, 1990a). In addition, we see the need for more research on computing activities which are not related to mathematics or programming and which involve the newer technologies such as the Macintosh. Finally, we find that most of the research on gender differences in computing has focused on why people (especially females) fear or don't like computers. We see a need for more studies which look at what women and girls *do like* about computers. Such shifts in research emphasis might better capture the "complexities of the problems" (Sutton, 1991, p. 494) with gender equity in computing.

Incorporating these recommendations and as an alternative to most of the studies described above, we designed a gender-sensitive computer attitude study in a gender-sensitive context. We posed the following questions: (1) What do females think about computers when given a chance to respond to open-ended questions rather than Likert scale questionnaires? (2) How do adolescent females behave in a multimedia writing environment which is expressive, visual, and non-mathematical? (3) Do both the open-ended written responses and observed behaviors support evidence that females are anxious about, uninterested in, and/or avoiding computers?

The Study

Three Harvard Graduate School of Education researchers conducted a multi-week observational study in a large suburban high school, just outside of Boston, during the spring of 1990. The study was a pilot test of the Personal Media Studio (Daiute & Johnson, 1990 in press) - Macintosh HyperCard-based multimedia writing software in which students enter images and sounds into the computer to use as springboards for developing text (Daiute & Morse, 1991, in press). The software is organized around the metaphor of a writing notebook, a photo album, an artist's palette, and a tape recorder - an environment with the potential to make "technology more interesting to females and writing more interesting to males" (Daiute, Johnson, and Morse, 1990, p. 1).

Methods

We describe our work as ethnomethodology - where "the researcher serves as participant observer within a field setting where he/she triangulates observation, the interview, and documentary analysis - not so different from investigative journalism" (Shrigley, 1990 p. 102). In such research, the emphasis is on social practices and interactions.

The first author was primary data recorder, circulating freely around the lab taking notes, but often called into action to assist with technical problems or questions from inquisitive students. Data sources included detailed field notes (from computer lab sessions over three weeks as well as two visits to the regular English classroom), interviews with students and teachers, meetings with the teacher and student teacher, and three open-ended questionnaires.

Subjects

This study involved 42 adolescents (25 females, 17 males), in two low-middle ability sophomore English classes. Ranging in age from 14 - 17, the students were racially and ethnically diverse (33% African American, 26% Portuguese, 17% White, 14% Hispanic, 5% Asian, and 5% Southern European). Over half were born outside the United States, and two were classified as ESL. Students were from primarily low income families (according to the teacher.) Ages ranged from 14 - 17. All of the students had some computer experience - at the minimum, a school-required, short introduction to IBM word processing as part of their ninth grade English classes. Few students had home computers.

Two teachers were involved - a female English teacher with 20 years experience in the school, and her young male student teacher. The teachers helped design the writing activity, but they played a minimal role in its implementation. Thus, the teacher role was filled by the three researchers (2 males and 1 female) who were skilled in using the hardware and software, certainly providing optimal (and untypical) technical assistance.

Computer Setting and Task

The computer lab was a recently-converted typing lab with 11 networked Macintosh computers, arranged in a U-shape, facing the center of the room, with one computer situated in the center of the lab. Other hardware included an Apple Scanner, MacRecorder sound digitizing devices, and three printers.

Working in same-sex, teacher-selected pairs, the students used the Personal Media Studio to scan into the computer photographs of themselves (taken by the teacher) which they then used to write autobiographies -- similar to those found on bookjackets. They worked on the task in the computer lab for seven class periods of 50 minutes each. Some

students voluntarily worked on their autobiographies after school, with researchers in attendance.

We present three findings from our larger overall results: (1) The open-ended Computer Attitude questionnaires, (2) A general Summary of coded behaviors in the lab, and (3) Specific behaviors involving the Macintosh mouse.

Findings: What Adolescent Females Think About Computers

Procedures

Before actually using the new software, students completed a self-administered questionnaire (given as a homework assignment) with 8 open-ended questions (three about computers, three parallel ones about writing, and two extra ones about writing) designed to find out (a) how they defined computers and (b) their Love-Hate relationship with computers. (See Table 1.)

Completed by 76% of the females and 88% of the males, the questionnaires were first analyzed for (a) word counts, (b) average-length responses, and (c) evidence of personalization as indicated by the use of the first person I). We then studied the responses and developed descriptive categories (Table 2) which emerged from the data (Miles & Huberman, 1984). For each question, we tallied frequencies of these categories.

Table 1
Instructions and Statements on Attitude Questionnaire

Thoughts about Writing and Computers
1. When you hear the word "computers", what comes to mind? Write everything you think about computers in the space below.
2. When you hear the word "writing", what comes to mind? Write everything you think about writing in the space below.
3. I like computers because
4. I don't like computers because
5. I like to write because
6. I don't like to write because
7. People need to be able to write because
8. People don't need to write because

Table 2

Computer Attitude Response Categories

General Terms

Terminology (traditional hardware and software words like *keyboard, disk*)

Nouns used to refer to computers (*machine, friend*)

Functions

Computer Functions (tasks or activities such as *writing, games*).

Affective responses.

Positive/Neutral Adjectives/Descriptors (expressive words such as *fun, easy*)

Negative Adjectives/Descriptors (words like *hard, confusing, fear*)

References to Computers Outside of the School setting

Future References (words related to using computers in jobs, careers, or life beyond high school).

Results/Discussion

Overall results showed that females appeared positive and enthusiastic about computing. Results in Table 3 show that on all three computer-related questions (#1, #3, #4) , females averaged more words per response than their less verbal male classmates. The females even wrote more total words on the three questions about computers than on the three questions about writing (#2, #5, #6).

Table 3

Overall Student Response Characteristics

	COMPUTERS								WRITING			
	Quest 1		Quest 3		Quest 4		Quest 2		Quest 5		Quest 6	
	F	M	F	M	F	M	F	M	F	M	F	M
# Responses	18	15	19	15	12	9	18	13	16	13	16	11
No Response	0	0	0	0	6	4	1	2	3	2	3	4
Total Words	172	112	180	112	97	58	142	94	126	100	110	61
Words/Response	9.5	7.5	9.5	7.5	8	6.4	7.9	7.2	7.9	7.7	6.9	5.5
Range	2--29	1-21	3-26	2-19	3-19	3-19	2-20	1-27	2-14	4-12	2-15	1-15
Number of Responses starting with:												
I			5	2	0	2			6	6	7	1
You			2	2	2	0			0	0	3	0
They			8	6	5	6						
It			2	5	1	1			7	7	4	5
Other			2	0	4	0			3	0	2	5

Question #1: ("What comes to mind when you hear the word computer?")

This was a popular question probably because it was first on the questionnaire, but maybe it was the subject matter. No student left this question blank. However, one female just rewrote the question verbatim with no additional thoughts, so her response was eliminated. Some students wrote lists of words while others wrote more complete sentences or phrases. The females responded quite thoroughly and in some ways, more expressively than the males, with more total words (172 versus 124..granted there were more females than males), as well as longer average responses (9.5 words versus 7.5

words per male response). Female answers ranged in length from 2 to 29 words while the males ranged from 1 to 21.

Contextual analysis of the responses (Table 5) revealed that there was no *standard* way to view computers. In the TERMINOLOGY category, we see that 5% of the total words used by females and 10% of the total words used by males referred to computer *buzzwords*. The most frequently mentioned computer part was "keyboard", mentioned by 20% males and 17% of the females. (Nobody mentioned a mouse or joystick.) Twenty percent of the males (no females) mentioned "disks" and "programs". "Screen" and "printing" were also mentioned by both sexes. Under NOUNS, there wasn't a clear-cut favorite. "Machine" (20%) was most often mentioned by the males. Only one female called the computer a machine. Two females thought of "technology". "Tool", "thing", and "brain" were also used by females. Two males (13%) mentioned the word "electronics". Interestingly, one male referred to the computer as a "friend".

Males used more TERMINOLOGY and NOUN words, but females used more FUNCTION words or phrases (25 for females, 16 for males) to describe computers, confirming the research which shows that males tend to think of computers as machines while females are more apt to think of them relationally -- as what they can do -- (CCT/CTE, 1991; Turkle & Papert, 1990). This FUNCTION category had practical as well as playful responses, both male and female. On the practical side, "typing" was frequently mentioned - even more often than "writing" (17% females, 7% males). Many students (27% female, 20% male) listed "typing" (as a skill) as well as "typing reports" (11% female, 7% male). Also, schoolwork and homework were often mentioned by both sexes (about 20% of both). On the playful FUNCTION side, "computer games", supposedly a male pastime (Loftus & Loftus, 1983; Becker & Sterling, 1987; Wilder, Mackie & Cooper, 1985), were associated with computers by both males (27%) and females (22%) (4 males and 4 females). Informal conversations later with some of the females indicated that they often played games on the computers in the school library.

Finally under FUNCTION, in spite of the early research portrayal of school computers as being the property of high school math and science departments (Collis, 1986; Becker & Sterling, 1987; Culley, 1988), this must not have been true for these adolescents. Only one student (a female) mentioned anything associated with math ("graphing") when asked to think about computers.

For ADJECTIVES/DESCRIPTORS, these adolescents' choices were overwhelmingly positive. The females accounted for 10 while the males only used 4. There was great variety in the descriptors used and no clear cut "most frequent". The word "smart" was used by three females (17%), in conjunction both with people ("smart

people") and the computer itself ("smart thing"). Some researchers have interpreted "I think of smart people" as being a negative descriptor -- as in "You have to be smart to use computers" (Pulos & Fisher, 1987). But "smart" could also mean "I use computers because I am smart" or "Smart people invent computers". It was not possible to tell the exact meaning from the responses. Also under DESCRIPTORS, one male mentioned that computers are "perfect", and two males and one female used the word "fun" in conjunction with computers. "Interesting, "easy", and "different" were also mentioned by females.

Overall, there were only 4 negative DESCRIPTORS used by females and only 3 by males. There were two female references (11%) to computers being noisy (no males) and two females (11%) admitted being confused when using computers. However, one of the females qualified her word "confusion" with "partial". No males used this word. The word "boring" (a very popular adolescent word) was only used once (by a male) and the "don't like" phrase was used by 2 males (no females). However, these two males were negative about everything regarding school and the project.

We see from "FUTURE/OUTSIDE WORLD" category that these adolescents think of computers in present-day. Futuristic robots and computer-controlled environments were not mentioned. However, the females mentioned words in this category more often than males. There were seven references to future or outside world issues by five different females (28%) and only two references ("future", "jobs") to future items by two males (13%). Only one student (a female computer owner) mentioned interest in a computer career ("I plan to go into computers as a career"). This is the same female who honestly admitted in Question #1 that sometimes computers are confusing, confirming as in Grant & Harding (1987), that perhaps females have a more reflective, complex view of computers.

TABLE 4:

"Question # 1 "When you hear the word computers, what comes to mind?"

CATEGORY	FEMALE RESPONSES (N=18) N %	MALE RESPONSES (N=15) N %
TERMINOLOGY		
Keyboard	3 (17%)	3 (20%)
Screen	2 (11%)	1 (07%)
Printing	2 (11%)	1 (07%)
Programs		3 (20%)
Disk		1 (07%)
Computer Science	1 (05%)	
Data		1 (07%)
Input		1 (07%)
Total	8 (5% of total words)	11 (10% of total words)
NOUNS		
Machine	1 (05%)	3 (20%)
Technology	2 (11%)	
Electronics		2 (13%)
Friend		1 (07%)
Tool	1 (05%)	
Thing	1 (05%)	
Brain	1 (05%)	
Total	6	6
FUNCTION		
Writing	3 (17%)	1 (07%)
Typing/Punching Keys	5 (27%)	3 (20%)
Typing reports, essays	2 (11%)	1 (07%)
Games	4 (22%)	4 (27%)
Work/Homework/Schoolwork	4 (22%)	3 (20%)
Thinking	2 (11%)	
Do Everything I like	1 (05%)	1 (07%)
Hold Information/knowledge	1 (05%)	1 (07%)
Help you/Do your work for you	1 (05%)	1 (05%)
Makes life Easier		1 (05%)
Letterwriting	1 (05%)	
Graphing	1 (05%)	
Total	25	16
ADJECTIVES/DESCRIPTORS		
	POSITIVE/NEUTRAL	
Smart	3 (17%)	
Fun	1 (05%)	2 (13%)
Easy	1 (05%)	
Fast/quick	2 (11%)	
Interesting	1 (05%)	
Different	1 (05%)	
Have their Own Minds (Information)	1 (05%)	
Perfect (don't make mistakes)		1 (07%)
All Right!		1 (07%)
Total	10	4
	Negative	
Noisy	2 (11%)	
Confusing (1 Partially)	2 (11%)	
Boring		1 (07%)
Don't Like		2 (13%)
Total	4	3

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TABLE 4 Continued...

CATEGORY	# FEMALE RESPONSES (18)	# MALE RESPONSES (15)
FUTURE/CAREER/OUTSIDE WORLD		
Future	1 (05%)	1 (07%)
Career	1 (05%)	
Money	1 (05%)	
Advancement	1 (05%)	
Business Know How	1 (05%)	
Resumes	1 (05%)	
People	1 (05%)	
Jobs		1 (07%)
Total	7 (5 females)	2 (2 males)

Question #3 - "I like computers because..."

As seen in TABLE 2, the students responded to this question similarly to Question #1 with the females writing more total words - 180 versus 112 - (not unusual since there were more of the females), as well as averaging 2 more words per response (9.5 versus 7.5). The males tended to use shorter three or four-word descriptive phrases while the females included more details. The female words ranged from 3 to 26 while the male word range was 2 to 19.

As seen in Table 5, responses fell into similar categories to Question #1. For FUNCTIONS, the females mentioned 16 while the males mentioned 11. The most frequent function for both males and females was GAMES, with 21% of the females mentioning games as a reason for liking computers and 27% of the males. (In fact, for one female, "games" was the only reason given for liking computers.) Thus again, it seems that games and fun are associated with computers by both sexes. The second most often mentioned FUNCTION by females was "learning new things" (16%). Only one male mentioned this. Interestingly, artistic reasons for liking computers were not mentioned by females, but rather by males. Two males mentioned drawing and one male mentioned "music" as reasons for liking computers. There was one female response of "making and creating things".

WRITING was mentioned often enough in various ways (especially by the females) so that it is included as a separate category. Five of the 19 females (36%) mentioned writing in their reasons for liking computers. Also, they mentioned writing in many different ways - as an activity ("write things") as well as the advantages for using

computers for writing ("erasing mistakes", "faster and less messy than handwriting", and "I can see what I write"). Fewer males (20%) mentioned writing, and with much less detail than the females, confirming the research on attitudes towards writing and the speculations that females' experiences with computers and writing (rather than computers and math or programming) can generate positive attitudes toward computing (Collis, 1986).

Under the category ADJECTIVES/DESCRIPTORS, in contrats to Question #1, the males used more (10) than the females (5). However, this was perhaps indicative of their writing style - shorter, more cryptic answers. Again we see that both males and females think computers are "fun" (4 females (21%) and 4 males (26%). The only other descriptor used by females was "interesting". Two males (13%) like computers because they are "interesting" and two (13%) because they are "so easy to use".

As in Question #1, not much association was made with computers and the future. There were only two FUTURE responses - both female.

Perhaps the most interesting finding from these Question #3 responses concerns the number of females who started their responses with the word "I" (first person). (Again see TABLE 2 .) The use of the first person seemed to denote a sense of active engagement and confidence -- "Because I can send messages" as well as personalization and affection for the computer -- "because I can play a lot of games". The third-person "they" and "it" ("because they are easy.."because it is fun") indicate a more distant, passive, and less personal response to technology. Although about 40% of both males and females started their responses with the third person "they", five females (33%) used the word "I" as opposed to 2 males (13%). Adding in the responses that started with the second person "you" ("because you can make things"..."because you can draw"), over one-third of the females (37%) as opposed to one-quarter (26%) of the males seem to relate to computers in an active, personal style. In addition, 33% of the males started their response with the word "it" (incorrect grammar or thinking the word computers is singular) versus 11% of the females.

TABLE 5:
Question # 3 "I like computers because..."

CATEGORY	FEMALE RESPONSES (N=19)	MALE RESPONSES (N=15)
FUNCTION		
Play Games/Play With	4 (21%)	4 (27%)
Learn/New Things	3 16%)	1 (07%)
Drawing		2 (13%)
See effects/what it can do	2 (11%)	
Typing/Like to/learn to	1 (05%)	1 (07%)
Send Messages	1 (05%)	
Graphing	1 (05%)	
Make/Create Things	1 (05%)	
Carry Information	1 (05%)	
Own One	1 (05%)	
Help you	1 (05%)	1 (07%)
Music Effects		1 (07%)
Do Homework		1 (07%)
Total	16	11
WRITING		
Write things	1 (05%)	1 (07%)
See what I write	1 (05%)	
Write what I like		1 (07%)
Quick to write	1 (05%)	
Easier/faster than typewriter	1 (05%)	
Easier to correct mistakes	2 (11%)	
Easier/Less messy than writing	1 (05%)	
Neater/professional looking		
Better than pen & paper		1 (07
Total	7 (5 females, 36%))	3 (3 males, 20%))
ADJECTIVES/DESCRIPTORS		
Fun	4 (21%)	4 (27%)
Interesting	1 (05%)	2 (13%)
Perfect (don't make mistakes)		1 (07%)
Easy to use/Just push a button		2 13%)
Adventuresome		1 (07%)
Total	5	10
FUTURE/CAREER/OUTSIDE WORLD		
Future	1 (05%)	
Career	1 (05%)	
Total	2	

Question #4 - "I don't like computers because..."

This question was designed to allow these students to articulate what they find annoying, troublesome or anxiety-provoking about computers. The most striking thing about this question was not the responses, but rather the LACK of responses (Table 2). Six females (32%) and four males (27%) left this question blank. Several of the students drew a line through the question number, perhaps indicating that they just weren't ignoring the question, but rather couldn't think of a good reason for not liking computers. One female and two males actually wrote in, "YES, I do" rather than leaving the question blank.

In addition to choosing not to respond, both males and females wrote less on this question. The females averaged 8 words per response (as opposed to 9.5 for the other questions), and the males averaged 6.5 (as opposed to 7.5 for the other questions). The male and female range of numbers of words was identical (3 - 19). The females, who on the other questions usually listed more than one reason for liking or using computers, only listed one reason for not liking them.

Analysis of the few responses generated different categories (primarily affective) from the first two questions. As shown in Table 6, males and females seem to have similar reasons for not liking computers - primarily they can be CONFUSING (33% females, 22% males) and sometimes break down - TECHNICAL GLITCHES (33% males, 25% females). One female mentioned that you have to know a lot about computers in order to use them well (perhaps showing a lack of experience) but this was not a frequent revelation by the females. One female wrote "you have to be careful with them."

There were several other small categories of responses. One male and one female mentioned typing difficulties ("I can't type") as a reason for not liking computers, and one each mentioned a negative association between computers and writing. Two females (17%) and one male indicated concern with computers being too controlling ("inhuman", "pretty soon everyone's going to be using computers").

The word "boring" finally appeared for females in this question. Two females (17%) versus two males (22%) listed "boring" as a reason for not liking computers. (The male responses were from the same two males who wrote "boring" on all their questions.) It is worthwhile to note that even males who are frequent video arcade users indicate "too boring" as their main dissatisfaction with this pasttime (Braun et al., 1986).

Unlike the responses to Question #3 (liking computers) where the females frequently used the word "I", only one female and two males used the word "I" (Table 2).

Most of the Question #4 responses (females 50%, males 77%) started with third person words (They, it). Perhaps, these adolescents feel more attached to computers when they are working properly, but feel out of control and less likely to want to associate with them when they encounter technical difficulties.

TABLE 6:

Question # 4 "I don't like computers because....."

CATEGORY	# Female Responses (N=12)	# Male Responses (N=9)
CONFUSING		
Confusing/Confusing keys	2 (17%)	
Hard to understand	1 (08%)	
Too complicated		1 (11%)
Hard to use if don't have one		1 (11%)
Need to know a lot to use one well	1 (08%)	
Total	4 (33%)	2 (22%)
TECHNICAL GLITCHES		
breakdown	1	
they don't work		1
trouble	1	
trouble to fix		1
screw up files		1
have to be careful with them	1	
Total	3 (25%)	3 (33%)
TYPING DIFFICULTIES		
Too many keys	1 (08%)	
Can't type		1 (11%)
Total	1	1
TOO CONTROLLING		
They do your thinking	1	
inhuman		1
Everyone will be using them	1	
Total	2 (17%)	1 (11%)
BORING		
can get boring	2 (17%)	
are boring		2 (22%)
Total	2 (17%)	2 (22%)
ASSOCIATED WITH WRITING		
we have to write on them	1	
don't like to write on them		1
Total	1 (08%)	1 (11%)
HATE		
hate them		1 (11%)

Although detailed analyses of Questions #2, #5, and #6 (parallel questions about writing) are not included in this paper, a brief comparison of the response results puts more perspective on how these adolescents, especially the females, view computers. (Again, see Table 2.) For example, on Question #2 - "When you hear the word "writing" what comes to mind?" - both males and females wrote less than on Question #1. Nineteen females wrote only 142 words about writing while eighteen females wrote 172 about computers. (We do acknowledge that the computer question was first on the questionnaire.) Thirteen males (two didn't answer) wrote 94 words about writing while fifteen wrote 112 about computers. In addition, the females averaged more words per response about computers than about writing - 9.5 words about computers and 7.8 words about writing. (The average for males was not different - around 7.5). Also, unlike Question #1 where few negative remarks were written about computers, there were 13 negative female descriptors (such as "Tired hands" and "Depresses me") and 7 negative male descriptors (such as "Oh NO" and "Don't Like it") about writing. And two females mentioned the word "boring" in conjunction with writing. So in spite of the fact that females are supposed to feel enthusiastic and competent about writing, they showed more of both qualities in their remarks about computers.

On Question # 5 - "I like writing because"- again the females wrote less than on the corresponding question about computers, averaging 9.5 words about liking computers and 7.8 words about liking writing. In addition, there were three "no responses" from females to this question. (All females answered the corresponding question about computers.). And surprisingly, more males (62%) than females (43%) wrote that they liked writing because through writing, they can "express feelings" (or "get things off my chest"). These results seem to be in contrast to some studies on male and female attitudes toward writing (Collis, 1986).

In summary, the responses to our open-ended questionnaire contradict many studies which show that males have more positive and responsive attitudes toward computers. (Chen, 1986; Collis, 1986; Wilder & Mackie, 1985). Furthermore, *computers* seem to mean different things to males and females, bringing up the issue of the appropriateness of using pre-determined questions and Likert-type scales to measure enthusiasm and emotional involvement with an object like a computer. When measurement was done with words rather than numbers, a new view of females and computers emerged.

FINDINGS: How Female Adolescents Behave in a Multimedia Computer Environment

Procedures

Using HYPERQUAL, field notes were broken down into "behavior units", usually 3 - 6 sentences describing an interaction or happening that could stand by itself. The behavior units could involve interactions between students, between students and adults (teacher, researchers), or between people and machines. These units were examined for patterns from which descriptive categories emerged (For example - HELP, PLAY, ENGAGEMENT, DISENGAGEMENT, SOFTWARE DIFFICULTY, MOUSE DIFFICULTY). These codes were then applied to all behavior units. Units were sorted by category and by gender and then analyzed. We report (1) a general summary of female behaviors in the lab and (2) an analysis of mouse behaviors. (For analysis of HELP behaviors, see Morse, 1990; Morse, 1991).

Results /Discussion: General Female Behavior in the Computer Lab

Summaries of coded field notes revealed a picture of females who were engaged and fascinated with the new technology (especially the scanner) - often "glued to the screen", confirming and extending their previous attitude responses. They sometimes worked with their Macintosh keyboards in their laps, like males typically do. The only documented swear words were uttered by a female. Although sometimes struggling with the mouse, the females often giggled about the problem and continued to improve. Contrary to some research (Chen, 1986; Becker & Sterling, 1987), the females were the only students who came after school to work with the Personal Media Studio. (One female even brought her boyfriend to the lab after school to watch her work at the computer.) The females, especially if inexperienced, sometimes hesitated to attempt something new on the computer, but with an encouraging word or hint (often from a researcher), usually would complete the task, appearing confident afterwards. There were even several cross-sex helping instances where females spontaneously left their own computers to assist male classmates in computer distress. The images, sounds, and text of this multimedia writing environment appeared "welcoming and nurturing" to the females, and seemed to provide them with multiple ways of thinking about, interacting with, and relating to computers (Turkle & Papert, 1990).

FINDINGS: Mousekeeping

Procedures

Because the first day of observations revealed that many females were having difficulty using a mouse, mouse usage became a focus of our observations. We made notes of difficulties as well as any interactions involving them. Coded field notes were

analyzed for trends and patterns. To triangulate our observations, we solicited opinions and feelings about using a mouse on our second survey wich contained the question: Write a few words about how you feel about using a mouse. Administered at the end of the autobiography project, the survey was completed by 22 females (88%) and 12 males (70%). Responses were analyzed for word frequencies and positive and negative descriptors.

Results/Discussion

In general, the males appeared more competent with the mouse. They perhaps had more experience with it, or perhaps playing video games gave them an edge. At least three of the males were quite good artists and used the mouse and the Personal Media Studio drawing tools to create elaborate cartoons or to add beards and mustaches to their scanned photographs. None of the females seem to have developed this type of interest or skill.

Whereas field observers noted only one male having trouble with the mouse, seven of the 25 females (28%) were observed having difficulties such as holding the mouse upside down, wandering way off the mouse pad, unsuccessfully double clicking, and positioning the pointer for inserting text.

Trends in the coded field notes revealed that the mouse seemed to have different meanings and functions for the females and males, in line with the work of Turkle and Papert (1990). For the males, the mouse became a new way to flirt as when a male would leave his seat and attract a female's attention by "playing around with her mouse". It also functioned as a tool for a new type of power struggle or turf war. Males would fight for the mouse (which gave them control over the screen or menu), often grabbing it from their partner or from a male another computer further away.

In contrast, the females seemed to experience the mouse as part of the "cozy appearance of the Macintosh" (Turkle & Papert, p. 154) - a small, cuddly item with which they could establish a personal relationship. One female called it "a cute little paddle". Many of the girls giggled when they were trying to move it. One female, who was experiencing difficulty even experimented with rolling the mouse on the palm of her hand, admitting that she liked it "because it didn't bite!"

With so many of the females experiencing difficulties in moving the mouse, we expected they might have negative attitudes toward its use when they responded to the survey question: Write a few words about how you feel about using a mouse". However, the results in Table 7 show the overwhelmingly positive and enthusiastic female response to the mouse ("Now this is an awesome instrument"). Of the 21 female responses, 17 (81%) were positive. Females averaged almost 10 words per response (versus 3.8 for the

males) - higher than any question on the first survey about computers. Although lacking much detail, the eight male responses were all positive.

In the positive responses, over half (52%) of the females used the word "fun" to describe using a mouse (versus 25% of the males). Three females wrote that they were novice mouse users, yet had only positive things to say about the experience, including "It is fun" from the lone female who swore at the mouse.

As seen in other research (Grant & Harding, 1987), the females were more reflective and articulate than the males about the advantages of this new technology. Five females (23%) responded that the mouse made it easier to move freely or improved their cursor accuracy ("you can go to any part of the screen"). The males (22% versus 10% females) simply wrote that "it was easier than using cursor keys."

The four females (20%) who wrote negative responses about the mouse mostly found it difficult to move ("it's hard to get the arrow where you want it"). Two females specifically wrote, "I don't like it." Only one female used the word "frustrating".

We also looked separately at the responses of the seven females whom we observed having trouble with the mouse. Only one responded negatively ("it was a pain because you have to leave it on the desk."), and one simply left the question blank. The other five (71%) had positive responses.

Table 7
"Write a few words about how you feel about using a mouse."

Overall Response Characteristics

	Females	Males
Total Words	209	30
# Responses	21	08
Avg/Response	10.0	3.8
No Response	1	3
"Joke" Response		1
First time for me	3 (14%)	
Positive Responses	17 (81%)	08 (100%)
Negative Responses	04 (19%)	00

Affective Characteristics

	FEMALES (N=21)	Males (N=8)
DESCRIPTOR	**# Occurrences**	**# Occurrences**
POSITIVE (From 17 females)		
Fun	11 (52%)	2 (25%)
Move more freely/accurately	6 (29%)	
Like it	3 (14%)	2 (25%)
Easier than cursor keys	2 (10%)	2 (25%)
Interesting	1 (05%)	1 (13%)
Different	2 (10%)	
Fast/Faster	2 (10%)	
Less Typing	1 (05%)	
Way Better	1 (05%)	
Awesome	1 (05%)	
Good		1 (13%)
Convenient		1 (13%)
Friendly (doesn't bite)	1 (05%)	
NEGATIVE (from 4 females)		
Don't Like it	1	
Frustrating	1	
Difficult to move	2	
It's a pain (sometimes)	1	
Have to leave it on the desk	1	

Conclusions

We asked the question, "Do observed behaviors and open-ended questionnaires support the research evidence that females are anxious about, uninterested in, and/or avoiding computers? Our answer is NO -- at least not the urban adolescents in this Macintosh multimedia writing environment. We saw females who were excited about computers, even play games on them, weren't shy about helping male classmates with a technical problem, and could even maintain a sense of humor when their mice were upside down and backwards. Perhaps more researchers should give females opportunities to express their ideas about computers rather than numerically rating pre-defined statements. With an alternative to a *Computer Attitude/Anxiety Test,* they expressed positive, enthusiastic, and confident feelings about computers. Likert scale computer attitude surveys are perhaps an example of the "mismeasure of woman" (Tavris, 1990).

The mousekeeping analysis illustrates the importance of using multiple data sources to understand the complexities of computing. Although several females were observed having difficulties with mouse movement, their responses to open-ended questions about this experience were positive, showing thoughtful analysis of mouse benefits. Had we assessed mouse opinions with a Likert scale question, "Do you agree or disagree with 'Using the mouse is easy'", we might have found "significant" gender differences in favor of males. By undertaking a "systematic effort to solicit disconfirming evidence" (McHugh et al., 1986, p.880), we uncovered different, but equal voices about Mice and Men and Women.

Although our results are encouraging, we recognize some validity threats. Validity was probably compromised by a "Harvard" (Hawthorne) effect. This was a research project using exciting new software which the students were pleased and honored to be testing. Although the attitude survey was administered before the project started, the excitement of a research atmosphere may have affected behaviors and later written opinions. In addition, the enthusiastic researchers were interested in giving the students a positive experience with the new software and played a major role in the success of the project, especially in providing technical support. Finally, we caution about generalizing our findings. Although our sample was culturally diverse, it was ,urban, academically homogeneous, and suffered a slight gender imbalance.

We think that the research on gender differences in computing attitudes and behaviors has not provided an adequate description of female attitudes or uses of computers. This project served as a model for our suggestions for improving such research. Rethinking how we ask questions and collect data probably makes our task

more complicated and time-consuming, perhaps more costly, limits the sample size in a study, and may cause some researchers to raise validity issues. But interpretative methods for eliciting student attitudes, in combination with observations in computer environments like the Personal Media Studio, which allow for multiple computer styles, represent a more equitable way to study, measure, and explain diversity in our computer classrooms. Certainly, we need to be concerned about the computer gender gap. Perhaps gender-sensitive methods in gender-sensitive contexts, as exemplified in this study, can help identify factors which might reduce the inequities.

In addition, these expected or predicted effects have undergone constant change as evidenced by the major shifts in the definition of *computer literacy* (Kay, 1989). Definitions have evolved from viewing the computer as an object to be studied and programmed to seeing it as a means for accomplishing educational goals such as thinking and writing.

Thus, there appears to be wide-spread evidence that "women are falling behind in their mastery of computers" (Dambrot, et al., 1985, p. 71).

Such language prevents "the recognition of the computer as a flexible medium adaptable to human needs" (Perry & Greber, 1990, p. 90)

Keller (1985) reminds us of the masculinity of science, questioning the metaphors and language of scientific thought with its emphasis on objectivity, domination of nature, logic, and formal truth-seeking. Building on Keller, Bower (1988) believes that "the computer represents yet another example of the "privileging of a masculine over a feminine way of knowing" (p.90). Pacey (1991) also talks about the confusion concerning the language of technology which has become a "catchword with a confusion of different meanings" (p. 3) some of which are value-free and some of which are "tied up with cultural values" (p. 4).

Although a few studies do identify specific situational factors which seemed to affect gender differences (Sheingold et al., 1983), such information is, more often than not, excluded from or ignored in studies.

Similar to the work of Gilligan (1982) in the moral domain, there is new research (CCT & CCE, 1991) which supports the view that men and women relate differently to computers. In interviews, open-ended questionnaires, and projective tasks about futuristic technological devices, researchers at Bank Street College's Women and Technology Project, found that men tend to see computers as machines which extend their power, getting excited about the computer itself while women approach the computer more relationally, seeking ways to capture its power for the service of and connection with other people. And Turkle & Papert (1990) (through observations and interviews) identified two distinct styles of relating to a computer - the concrete relational style associated with females and a more traditional mastery style more associated with males. They call for an "epistemological pluralism" (both in practice and in research) which will recognize and value both styles.

which result from "not appreciating the computer as an expressive medium and not allowing different styles to flourish" (Turkle, 1986, p. 15).

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